Third United Nations International Conference on the Peaceful Uses of Atomic Energy

A/CONF.28/A/750
INDIA
February 1964
Original: ENGLISH

Confidential until official release during Conference

Abstract

RELATION BETWEEN THE ORIGIN, POWDER CHARACTERISTICS AND SINTERING TREATMENTS ON THE DENSIFICATION AND MICROSTRUCTURES OF COMPACTS OF URANIA AND THORIA

V.K.Moorthy, A.K.Kulkarni and S.V.K.Rao
Atomic Energy Establishment Trombay

The relations between the origin, powder characteristics and sintering treatments on the densification and microstructure of compacts of (1) urania and (2) thoria have been studied. The oxide powders were prepared by thermal decomposition of uranyl and thorium compounds viz. tannate, benzoate, oxalate etc. The microstructure of a sintered compact influences some of its physical properties such as thermal conductivity and fission gas retention and as such is an important factor responsible for the difference in performance of pellets of the same density during service in a reactor.

The oxide powders derived from the various compounds showed significant differences in their crystallite size; oxide powders from the same compound, calcined at higher temperatures had an increased crystallite size and lowered surface area. In this study, UO_2 sintering was carried out in hydrogen and ThO_2 sintering in air. In both the cases, powders with smaller crystallite size started densification at a lower temperature and attained high densities at significantly low temperatures (1200 - 1300°C), other conditions of sintering treatment being the same. There was an optimum temperature for each of the powders, to attain the maximum densification.

The influence of the period of soak at the sintering temperature on

the densification of these powder compacts was studied. At certain time intervals, specific for the powder and the sintering temperature, significant lowering in densification was noticed. The extent of drop in density, and the time of its occurrence at each of the sintering temperatures were related to the origin and characteristics of the powder used.

The study of the microstructures revealed that the changes in densification were due to the formation of closed porosity during the heating period and its subsequent enhancement during the sintering treatment. Grain development depended to a larger extent on the temperature than on the sintered density attained. Minor impurities, atmospheres of sintering etc. also exert an influence on the densification and grain growth, e.g. traces of titania in urania promote both densification and grain growth at lower temperature ($\simeq$1100°C).

Thus, the sintering characteristics of urania and thoria powders depend on the origin and powder characteristics (including presence of minor impurities). To prepare sintered compacts approaching theoretical density, from any given powder, the sintering conditions should be so chosen as to avoid the formation of closed porosity. The sintering temperature could be maintained sufficiently low without any appreciable grain growth taking place, even though a density over 95% theoretical is attained. Grain growth, if desired, can be obtained by a subsequent heat treatment.